EXHIBIT 13

SOFTWARE UNIT EXTERNAL FUNCTIONAL SPECIFICATION
Feature: OSPF NSSA and Demand Circuit
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I Problem Definition

(1) NSSA

There are circumstances that require redistribution of external routes into remote access router, which has limited memory, connected to the core through slow speed link.

Since the core usually carries a lot of external routes, it is not desirable to put the remote access router within regular OSPF area as the external LSAs will overwhelm the access router and satuate the link. To avoid flooding external LSAs into the access router, it must be put within stub area. However, stub area does not allow redistribution.

To resolve this dillemma, OSPF NSSA is introduced.

NSSA area is similar to OSPF stub area but has the ability of importing AS external routes in a limited fashion.

It allows importing of type 7 AS external routes within NSSA area. These type 7 LSAs are translated into type 5 LSAs by NSSA ABR, which is then flooded thoughout the whole routing domain. Summarization is support during translation.

(2) Demand Circuit

OSPF relies on periodic hello to detect neighour availability and periodic refresh of LSA to ensure database consistence. It causes OSPF to operate inefficiently over "demand circuit" like ISDN, X.25 SVCs and dial-up lines as the circuit is kept open forever by the periodic protocol data.

With OSPF demand circuit, periodic hellos are suppressed and periodic refresh of LSAs are not flooded over demand circuit. It allows the underlying datalink layer to be closed when the topology is stable.

II Design Considerations

(1) NSSA

Overload the redistribute command to redistribute route into type 7 LSA within NSSA area. If redistribute command is invoke on NSSA ABR, it should generate type 5 LSA into regular area and type 7 LSA into NSSA area. Configuation option is needed to prevent redistribution into NSSA area in this case.

Enchance summary-address to allow summarization and filtering of type 7 LSA during translation on NSSA ABR. If other route redistribution is done on the same NSSA ABR such that there are both type 5 LSAs and type 7 LSAs fall within the same range, we should ignore the type 7 LSA and do not perform translation. In this case redistribution should also generate the type 7 summary LSAs into the NSSA.

Extend the external LSA build function to build type 7 LSA too. Enhance the periodic route redistribution function to perform type 7 to type 5 translation.

(2) Demand Circuit

Change the neighbor and interface state machine to implement suppression of hello. Information about suppression of hello is kept with neighbor structure rather than the interface structure so that negotiation can be done on a per neighbor basis over point-to-multi-point interface.

LSA processing should be modified to handle DoNotAge LSA. To simplify the change, we record the DoNotAge bit of the LSA upon receiving and clear the DoNotAge bit of the LSA age before storing it into database. So there is no need to change any macro and function that do age comparsion.

OSPF is not responsible to close the circuit when it is idle. It is assumed that dial on demand is configured on the OSPF demand circuit and responsible to close the circuit for us.

A registry should be added which notify OSPF when a call attempt failed. The callback should give the idb on which the call is attempted and the next hop address related to the call. OSPF will use these information to remove the stale neighbor entry.

III Memory and Performance Impact

The two features together increase the code size by about 10k.

(1) NSSA

NSSA requires a new database for type 7 LSAs. If current stub area is converted into NSSA area to import external routes, care should be taken to make sure there is sufficient memory. Every type 7 LSAs take about 133 bytes.

(2) Demand Circuit

No specific issue.

IV End User Interface

(1) NSSA

Two router commands are extended to support NSSA.

area <AREA-ID> nssa [no-redistribution] [default-information-originate]

This command is used to configure an area as NSSA.

The no-redistribution keyword is used when the router is a NSSA ABR and we want the redistribute command to only import routes into normal areas but not into the NSSA area.

The default-information-originate keyword is used to generate a

type 7 default into the NSSA area. This command only take effect on NSSA ABR.

summary-address <PERFIX> <MASK> [not-advertise] [tag <TAG>]

This command is used to control the summarization during type 7 to type 5 LSA translation.

The not-advertise keyword is used to suppress route that match the PREFIX/MASK pair.

The tag keyword is used to specify the tag value for the type 5 LSA generated.

(2) Demand Circuit

One interface command is added.

ip ospf demand circuit

This command configure OSPF to treat the interface as demand circuit. On point-to-point interface, only one end of the demand circuit needed to be configured with this command.

V Configuration and Restrictions

(1) NSSA

Every routers within the same area must agree that the area is NSSA.

(2) Demand Circuit

It is advised to encase demand circuits within OSPF stub areas or within NSSAs to isolated the demand circuits from as many topology changes as possible.

To take advantage of demand circuit functionality within stub area or NSSA, every routers in the area must run DC capable image. If demand circuit is deployed within regular area, all other regular areas must be converted to the DC capable image before the demand circuit functionality can take effect.

VI Testing Considerations

(1) NSSA

New test scripts are needed to test the followings.
- Redistribution of route as type 7 LSA within NSSA area
- Translation of type 7 LSA into type 5 LSA on right NSSA ABR
- Summarization during translation
- Generation of type 7 default

(2) Demand Circuit

New test scripts are needed to test the followings.
- Suppression of hello
- Generation and flooding of DoNotAge LSA
- Interoperability with unmodified OSPF routers

- Virtual link support
- Point-to-multipoint interface support

VII Reference Documents

(1) NSSA
/rfc/RFC/rfc1567.txt

(2) Demand Circuit
/rfc/RFC/rfc1793.txt